

# Descriptions of Courses

## **BS120 General Biology**

This general biology class is designated to make freshmen understand concepts of biology and their connections to their lives. Thus, students can understand the basic knowledge and appreciation for how science works in an era when informed decisions regarding health, environmental problems and applications of new technology are prevalent.

## **BS122 Diversity of Life**

It aims to raise interest in life sciences through the introduction of modern biology which is expanded through the convergence of disciplines and lectures on macro-level phenomena in biology that can not be covered in general biology. This course is selected by students who major in biology-related departments.

- Understand the diversity of life and the similarities found in living species.
- Understand how living things are classified, how they have evolved, and how they interact each other.
- Introduction to modern biology which is expanded through the convergence of disciplines.
- Experience biological research through experiments and creative team projects.

## **BS200 Biochemistry Experiment**

Selected experiments covering the study of the properties of biomolecules are performed in order to expose the students to techniques commonly used in a biochemistry lab, introducing them to modern experimental methods in biochemistry including separation, identification, and characterization of biomolecules.

## **BS202 Cell Biology**

A series of lectures on cell biological subjects; Cell composition, cell structure, Cell cycle regulation, cytoskeleton, Membrane, Transport, Protein Sorting are given in this course.

## **BS205 Biochemistry**

This course is designed for junior students to have an ability to understand the principles of basic enzymology, bioenergetics and cellular metabolism. The roles played by the two major biomacromolecules &#8211; proteins and carbohydrates - in these biochemical processes will be discussed over the course of the semester. Generally the first half of the course is structural biochemistry with enzyme kinetics, protein function, signal transduction and thermodynamics. The second half of the course is mainly glucose metabolism including glycolysis, TCA cycle, oxidative phosphorylation, and photosynthesis.

## **BS208 Metabolism-inspired Drug Discovery**

Metabolism-based drug discovery is a 3-credit course for the undergraduate students to introduce the principles of bioenergetics and cellular metabolism for the application of treating major human disease such as diabetes and cancer. The properties and metabolism of important biomolecules in these biochemical processes will be comprehensively introduced throughout the semester. In particular, the process of drug discovery inspired by metabolic processes will be reviewed and highlighted.

## **BS209 Molecular Biology**

This course will cover the integrated introduction to the studies of genes and their activities at the molecular levels including: Mechanisms of gene regulation at the level of transcription, Translation, Replication, and Recombination. One of key features of this course will be the layering various approaches to the detailed mechanisms.

### **BS223 Introductory Biotechnology**

This course consists of two parts. The first part is to define and explain about the biotechnology inductively based on the people who contributed to the development of the "Biotechnology" which will help students understand the allure of the scientific enterprise and the passion with which the best researchers approach their work. The second part is to discuss with students how the biotechnology is applied in health care, agriculture, and environment and its relationship with nanotechnology and information technology.

### **BS232 Microbiology**

This course provides basic concepts on the fundamental aspects of microbiology, including genetics, physiology, and classification. Based on these background, various applications to microbial industries will be discussed.

### **BS307 Physical Chemistry for Life Science**

The goal of this course is to understand the biophysical properties and principles of biological processes.

### **BS310 Genome Molecular Biology**

Among the vast contents of molecular biology studying expression of genes and genomes, some basic contents are covered in the <BS209 Molecular Biology> course and the remaining contents are covered in this course. They include chromosome structure and function, cell cycle, chromosome segregation, regulatory RNA, DNA repair and recombination, transposition, genomics, and genetic variation.

### **BS311 Animal Diversity**

This lecture provides fundamental and comprehensive knowledge of the animal phyla with emphasis on the diagnostic characteristics, diversity, evolutionary relationships, and functional adaptations.

### **BS312 Evolution**

This course will cover general knowledge of evolution and ecology : Darwinism, evidence of evolution, processes and patterns of evolution, and interactions and homeostasis in ecosystems. The goal of this course is to provide students with macroscopic insight for the life sciences through understanding how evolution proceeds by interactions of organisms with their environment.

### **BS315 Genetics**

The course deals with the rules of inheritance underlying the phenotypic consistency of an organism. Detailed topics include the transfer of genetic information, recombination, mutagenesis, genetic regulatory mechanism, and genes associated with disease and development. The quantitative approaches to population and evolutionary genetics will also be introduced.

### **BS316 Introduction to Epigenetics**

Introduction to Epigenetics is a middle level course, aimed at juniors and seniors. It is designed to give a good background in biochemistry and genetics, which should allow for easy continuation to

undergraduate school courses. The major themes are eukaryotic gene structure and function, histone modifications and their functions in cells. This course will be focused on general mechanistic aspect of epigenetic phenomena in various organism.

### **BS318 Developmental Biology**

In this lecture course, we will deal with the developmental processes by which the genes control cell differentiation and determine pattern from fertilized eggs to adults. In particular, we will emphasize developmental principles and concepts of developmental biology by understanding how genes control the developmental processes in *Drosophila* and in vertebrates.

### **BS319 Cell Biology Experiment**

This course will deal with basic cell biology experiments as well as basic principles of microscopes. In addition, this course will focus on current cell biology technologies such as live, fixed cell imaging and analyses.

### **BS322 Cell and Biological Engineering**

This course intends to provide an overview of cell and biological engineering, by introducing the various technologies used for biomedical applications, such as biopharmaceutical development, gene therapy, and diagnostics.

### **BS326 Biotechnology Experiment**

This course is designed to gave students understand the principles of biological engineering related to various bioprocesses using microbes and enzymes. In addition, the part of laboratory course is designed to train students basics biological engineering experimental techniques and practice.

### **BS342 Enzymology**

In this lecture we have tried to give a broad account of enzymology and have aimed to put current knowledge into prospective. To study enzymes will be helpful to understand a crucial role of catalysis in metabolic process of living organism. Because of the complexity of such processes, it is necessary to gain an insight into the properties of enzymes in simpler systems such as isolated entities in the test tube. Next we followed a progression from the properties of isolated enzymes to the behavior of enzymes in complex systems, leading up to cells. We include discussion of the importance of enzymes in medicine and industry to emphasize that enzymology is not purely academic but has increasingly wide applications.

### **BS346 Animal Behavior**

Behavior is essential for the gain of success in survival and reproduction by which a lot of animals interact with environment and cooperate each other. This lecture deals with the principles on the development and expression of behaviors at the level of undergraduate students.

### **BS355 Pharmacology**

Students taking this class will gain the necessary understanding of fundamental principles of pharmacology, emphasizing molecular mechanisms of drug action and principles of drug-receptor interactions, drug absorption/pharmacokinetics, drug metabolism, etc.

### **BS357 Introduction to Neuroscience I**

This lecture introduces the history and basic principles of neuroscience and recent understandings how the structure and physiology of neurons contribute to the brain functions and the control of

behaviors. Lectures mainly deal with contents described in the text and present some recently defined principles or results in the field of modern neuroscience.

### **BS358 Plant Biology**

The plant constitutes an important group of living organisms which provides not only foods but also many medicinal drugs, perfumes, and construction materials. The lecture will cover various introductory plant-related topics including photosynthesis, secondary metabolism, and plant development.

### **BS367 Biomolecular Chemistry**

Biomolecular Chemistry is designed specifically for the one-semester short course in organic chemistry. This course is intended for students who do not major in chemistry, particularly who major in biological sciences, and who want to acquire essential knowledge of organic chemistry and reaction.

### **BS413 Experiments for Genetics and Developmental Biology**

Learning experimental tools and data analyses applicable for the studies on organism in terms of genetic and developmental aspect.

### **BS414 Ecology**

This course introduces various interactions of species with each other and with the environmental factors and the analytical methods used in ecological research. Students also learn basic ecological science to understand modern environmental problems.

### **BS415 Genomics**

This course provides an overview of Human Genomics including epigenetic gene regulation. The course topics include current and novel genomic/epigenomic technologies including RNA-seq, ChIP-seq, Hi-C, and etc and a brief overview of genomic/epigenomic data analysis.

### **BS416 Molecular Genetic Techniques**

Molecular genetic techniques are one of the most important tools used in modern biology. The goal of this course is to train students to be equipped with knowledge ranging from classical genetics to up-to-date molecular genetic techniques, including CRISPR/Cas9 genome editing, at the senior undergraduate level. Thus, the focus of this course is learning current molecular genetic concepts and techniques for addressing fundamental biological questions as experimental biologists.

### **BS417 Eco-Evo-Devo**

This course integrates multiple subjects to teach a syncytial science that is required for new generation of biologists. It will focus on the importance of environment, endocrine disruptors and symbionts on organismal development and disease. In addition, this course provides new aspects of evolution by integrating genetics, symbiosis, and plasticity.

### **BS431 Virology**

This course is designed to provide students with basic and medical characteristics of viruses. It deals with classification, replication, and transcription of viruses. Viral structure and functions are also

covered.

### **BS433 Molecular Biology of Gene Regulation**

This course will cover the integrated introduction to the studies of genes and their activities at the molecular levels including: mechanisms of gene regulation at the level of transcription, chromatin structure, DNA methylation, RNA processing, mRNA localization, protein synthesis and degradation, and DNA replication. One of key features of this course will be layering various approaches to the detailed mechanisms.

### **BS435 Bio-Imaging**

This course will deal with the principles of microscopy and applications to understand biomolecules and cells as well as diverse fluorescent proteins that are essential in current biology. In addition, the course will focus on various imaging technologies such as FRET, FLIM, and TIRF.

### **BS442 Stem Cell Biology**

To expand the fundamental knowledge of regenerative medicine, this subject is focusing on understanding the molecular and cellular mechanisms of stem cells, including pluripotency, differentiation, stem cell niche and epigenetic reprogramming.

### **BS450 NeuroscienceII**

This course, using textbook based teaching, is aimed to provide students with higher level of knowledge and understanding about topics in neuroscience that is not covered in basic neuroscience course.

### **BS452 Immunology**

The course deals with the basic concept of immune system including immune cells, diverse cytokines and their interactions both at cellular molecular levels.

### **BS453 Physiology**

Understanding toward co-ordinations and intergrations of physiologic processes in the body at the level of nano-molecular-cellular-tissue-organ levels.

### **BS454 Introduction to Structural Biology**

An introductory course about structural biology involving X-ray crystallography, which has contributed enormously to the current understanding of biological systems. This lecture will cover the historical development of X-ray crystallography, its contribution to our knowledge about three-dimensional structures of biological molecules, enzyme mechanisms, signal transduction, other biological processes and also drug discovery.

### **BS456 Behavioral Physiology**

This course will focus on aspects of neuroscience related to behavior. We cover basic neuronal physiology, the structure/function of the nervous system, sensory systems and several higher-level cognitive systems. This course will focus on human neuroanatomy and behavior.

### **BS458 Synthetic Biology**

The goal of this introductory course is to provide theoretical backgrounds to understand synthetic biology and its applications. In addition, we will deal with cutting edge high-throughput technologies such as next-generation sequencing as emerging toolboxes.

**BS465 NanoBioTechnology**

This course deals with how the basic principles of nanotechnology can be integrated into biotechnology and what industrial fields will be created by this consequence in the future.

**BS467 Biomaterials**

This course is an introduction to basic principles of materials science and cell biology underlying the design of medical implants, drug and gene delivery systems, artificial organs, molecular imaging, and matrices for tissue engineering.

**BS469 Scientific communication**

A successful scientist must be able to effectively communicate his or her ideas and discoveries to peers around the world via publication in international journals, poster presentations, and scientific lectures. This course, which will follow a modified journal club format, is designed to help graduate students learn to better communicate scientific ideas with their colleagues. Students will learn how to critically evaluate primary research papers and will practice presenting their thoughts in a group setting. These skills are invaluable, especially for students planning an to enter graduate school and pursue an academic carrer in the biological sciences.

**BS481 Topics in Life Science I**

This course selects a topic that has drawn the particular attention of biological scientists. Discussion will be concentrated on how original discoveries were made, what progress was achieved later on, and what major controversies currently exist, as well as future directions.

**BS482 Topics in Life Science II**

This course selects a topic that has drawn the particular attention of biological scientists. Discussion will be concentrated on how original discoveries were made, what progress was achieved later on, and what major controversies currently exist, as well as future directions.

**BS483 Topics in Life Science III**

This course selects a topic that has drawn the particular attention of biological scientists. Discussion will be concentrated on how original discoveries were made, what progress was achieved later on, and what major controversies currently exist, as well as future directions.

**BS484 Topics in Life Science VI**

The major goal in this course is to provide participants with advanced knowledge, recent research trends and important discoveries in neurobiology and is also to enhance the understanding of neurobiological principles through presentation and in-depth discussion.

**BS485 Topics in Life Science V**

This course will provide an introduction to advanced cell biology and will cover the following topics: cell chemistry, transcription, translation, cell architecture, metabolism, signal transduction pathways, cell division, and the cell cycle. Students will also learn current molecular biological techniques that are used to study these topics in the laboratory.

**BS486 Topics in Life Science VI**

This course will deliver and overview and current topics of cutting edge bioengineering technologies and methods to students who major in biology.

**BS490 B.S. Thesis Research**

Each student is required either to perform an original research or to write an extensive review article for a M.S. thesis.

**BS495 Specified Research**

This listing is for participation in advanced research under direction of a selected faculty member.

**BS496 Seminar**

This selection is offered to all students as part of the core curriculum. Recent and interesting work regarding selected issues in modern biological studies is included.

**BS501 Bioassay Standards**

This course covers basic principles and practical parameters of biological assays and biostandards. These include expression and purification of nucleic acids and proteins, cell culture, mass spectrometry, microscopy, flow cytometry, etc.

**BS507 General Clinical Medicine**

This course designed to give students a basic understanding of clinical medicine. Topics include etiology, pathophysiology, diagnosis and treatment of human diseases. The each lecture will be given by a specialist in the each clinical area.

**BS510 Neural control of Metabolism & Behavior**

This class will cover the fundamental principle underlying the function of nervous system mediating innate and learned behaviors to external and internal stimuli such as olfactory, gustatory, thermal and social cues, as well as metabolic and physiological needs. We will present modern molecular genetic, electrophysiology and imaging technology to address important problems in neural circuits, metabolism-related innate and learned behaviors and students will attain a deep understanding of how and when to apply various techniques.

**BS512 Biostatistics**

The course deals with descriptive and analytical method of biological phenomena, and the topics treated include distributions of statistical tests, analysis of variance, regression and correlation.

**BS513 Synthetic Immunology**

This course covers the general biology of immune effector cells and introduces students with specific examples of how modern synthetic biological tools, such as antibody engineering, gene therapy, and genome engineering, have been applied to manipulate the immune system to develop novel therapeutic approaches.

**BS515 Behavioral Genetics**

Behavioral genetics is to explore the genetic basis of behaviors. This lecture will also deal with key methods in behavioral genetics including gene-targeting, inbred mouse usage and behavioral tests for sensory-motor, emotion, learning and memory and etc.

**BS516 Advanced Genetics**

Genes of the higher eucaryote are characterized by complex structures and their activation is restricted by various methods. This course examines the biological significance of such structures and functions and helps students create insight into the activation of genes through

post-transcriptional modification by methylation. Moreover, it will cover specific examples of medical applications concerning the unique regulation mechanism of sex chromosomes.

#### **BS517 Disorders in the Nervous System**

This course introduces symptoms and underlying mechanisms for various neurological and psychiatric disorders to help students better understand brain functions and perform more clinically-relevant basic neuroscience researches.

#### **BS521 Cancer Biology**

This course is an in-depth introduction to cancer biology including cellular, molecular, biochemical and genetic aspects. Students will also be exposed to the application of fundamental knowledge to cancer prevention, diagnosis, prognosis and therapy. Formal didactic lectures on each weekly topic will be followed by students' presentation of original scientific literature. The course is intended for graduate students and advanced undergraduates.

#### **BS525 Gene Expression**

This course provides students with an understanding of fundamental principles underlying various steps of gene expression with an emphasis on molecular mechanism of transcription regulation. Topics include the mechanistic steps of transcription, the roles of transcription factors, regulation of gene transcription, RNA processing and editing, translational post-translational control.

#### **BS528 Advanced Epigenetics**

The regulation of gene expression in many biological processes involves epigenetic mechanisms. This class is intended for those working in the field, as well as being a suitable class for advanced undergraduate and graduate courses on gene regulation.

#### **BS542 Immunotherapy**

This course is for upper-level undergraduate students and graduate students. It aims at getting students to witness and learn how basic knowledge of immunology is translated into developing new therapeutics in clinics and industry. This course will encompass a variety of immunotherapies to control inflammation, immunologic diseases, transplantation, and cancer. Lectures in each topic will be supported by reading and discussing primary literature.

#### **BS543 Advanced Neurobiology**

This course will study basic aspects of neurons (development, synaptic transmission and synaptic plasticity) and molecular mechanisms underlying various brain functions (i.e., sensory-motor system, sleep and memory) and dysfunctions (i.e., schizophrenia).

#### **BS547 Neural Development**

The objective of this course is to understand the basis of neural development in molecular and cellular levels of the nervous system from genes to memory and behavior of the animals.

#### **BS549 Biology of Metabolism**

This course offers the basic metabolic pathways in the biosynthesis and degradation of cellular metabolites. Particularly, diverse modes of small molecule actions in the control of signaling network will be highlighted.



### **BS553 Omics Biology**

The goal of this introductory course is to provide students theoretical backgrounds to understand genomics, transcriptomics, proteomics and metabolomics. In addition, biostatistics basics is provided for the statistical analysis of biological data.

### **BS554 Advanced Biological Engineering**

This course deals with the handling of the bioreaction of enzymes and microbial cells in the various types of bioreactors, in order to make the bioreactors, in order to make the bioprocesses more economically feasible. It covers the following topics: Interpretation of principal ideal reactions, Kinetics of biocatalytic reactions, Design and analysis of bioreactors, Control and optimization of bioreactors. Certain segments of BS324 are discussed here in more depth.

### **BS562 Protein Design**

This course will focus on principles and progress in design of proteins with desired functions as well as on the fundamental aspects of proteins.

### **BS564 Bioanalytical Technology**

Analytical targets in Biochemistry/Biology include small molecules with biological activities, bio-macromolecules (proteins, nucleic acids, carbohydrates, and lipids), cells and animals. This course will be focused on principles in various analytical methods used in research of Biochemistry/Biology.

### **BS566 Bioconjugate Chemistry**

The technology of bioconjugation has affected nearly every discipline in the life sciences. This course will cover three main sections of bioconjugation: its chemistry, reagent systems, and principal applications.

### **BS571 Advanced Animal Cell Engineering**

The course will provide the students with basic knowledge on cell functions needed for cultivation of animal cells. In addition, the students will be informed about the production of therapeutic proteins from animal cells. Discussions will be also held on recent trends concerning the tissue engineering of human bone marrow, epidermal, and liver cells.

### **BS584 Novel Drug Delivery Systems**

This is a general education course of novel drug delivery systems (DDS), introducing sustained-release DDS formulation and targeted drug delivery systems. The importance and current problems concerning stabilization and formulation of DDS and gene delivery systems are the major topics of discussion in this course, as well as the design of polymeric scaffold systems for effective drug delivery.

### **BS585 Advanced Developmental Biology**

To improve the fundamental knowledge of animal development, this subject is focusing on understanding the molecular and cellular mechanisms of major mammalian developmental events, including oogenesis, spermatogenesis, fertilization, early embryonic development, implantation and organogenesis.

### **BS586 Plant Developmental Biology**

The plant, an important group of living organisms which provides not only foods but also many

medicinal drugs, perfumes, and construction materials, has evolved separately from the animal, thus the extrapolation of knowledge gained from the animal has the limited use. Since our existence on Earth depends so much on plants, however, it is necessary to understand how plants develop themselves and maintain the integrity as multicellular organisms. This lecture will cover how plants develop themselves and how plants maintain the integrity at the molecular levels.

### **BS588 Cell Signaling**

This course explores advanced topics in cell signaling related to cell proliferation cell death, cell cycle, and so on. Some topics covered include the following: protein kinases and their function, phosphatases and their role in regulation, growth factor receptors and G-proteins, calcium and other second messengers, cell cycle and immune system signal transduction events, etc. A basic review of overall related researches will be provided, and current findings from the scientific literature will be discussed.

### **BS589 Cancer Genetics**

Cancer Genetics will discuss the functions of oncogenes and tumor suppressors which are frequently altered in various cancers. In addition, this will discuss the molecular mechanism by which these altered expressions promote tumorigenesis and modern cancer genetics.

### **BS611 Advanced Molecular Cell Biology I**

This course covers recent advances in most areas of modern life sciences which graduate students should be acquainted with for their own thesis researches. The course will place a particular emphasis on basic processes of cell biology.

### **BS612 Advanced Molecular Cell Biology II**

This course is the continuation of Molecular Cell Biology I, which will cover the recent advances in several fundamental biological phenomena occurring at the level of cells with a particular emphasis on their molecular and mechanistic aspects.

### **BS613 Cellular and Molecular Immunology**

This lecture will provide the students with basic and comprehensive concepts of modern immunology in cellular and molecular level. Topics include development of immune system, innate and adaptive immunity, recognition of antigen, lymphocyte development and activation, and immune system in health and disease.

### **BS614 Advanced Systems Neuroscience**

This course aims to update recent advances in the field of systems neuroscience related to sensory processing, motor control, learning and memory, decision making, and emotion. Each student must perform in-depth literature review related to a particular research paper and discuss the outcome in the class.

### **BS632 Advanced cancer biology**

This course will provide students with a comprehensive understanding of molecular and cellular mechanisms governing carcinogenesis, cancer progression, and metastasis. Furthermore, this class will introduce the most recent treatment options and clinical trials on cancer patients with metastatic diseases.

### **BS711 Bioinformatics**

The course provides graduate students with an overview of the characteristics of biological information, organization, and processing mechanism, and introduces various approaches to simulate those systems.

### **BS723 Cell Signaling Networks**

The goal of this course is to provide students with fundamental understanding of intracellular signaling and intercellular communications. It will also provide them with new concept of drug development targeting cell signaling. In this class, I will focus on the intracellular signaling pathways responsible for cancer metastasis, cell migration and epithelial-mesenchymal transition.

### **BS740 Selected Topics in Cell Biology**

This course is designed to provide doctoral degree candidates with the current advancements of cell biology research with a few specific topics of contemporary interest.

### **BS750 Selected Topics in Biotechnology**

The purpose of this course is to give graduate students the most up-to-date information about biotechnology. Topics are decided by instructors. Covered topics are as follows: molecular biology, industrial microbiology, biochemical engineering biomedical technology, and cell cultures.

### **BS791 Scientific Writing in English**

The course is intended to improve graduate students ability to present their research results at international scientific meetings and to write manuscripts for international scientific journals. Students taking this course are to learn structural management and technical pitfalls in scientific writing. They will also practice writing and proofreading of scientific papers.

### **BS803 Advanced Topics in Life Science III**

The course provides graduate students with an overview of the characteristics of biological information, organization, and processing mechanism, and introduces various approaches to simulate those systems.

### **BS960 M.S. Thesis Research**

This listing is for participation in advanced research under the direction of a faculty member.

### **BS965 Independent Study in M.S.**

This listing is for participation in advanced research under the direction of a faculty member.

### **BS966 M.S. Seminar**

This selection is offered to all students in biological sciences as a core curriculum course. The course covers recent relevant and interesting research in modern biology.

### **BS980 Ph.D. Thesis Research**

This is advanced research under the direction of a faculty member.

### **BS986 Ph.D. Seminar**

This is offered to all students in biological sciences as a core curriculum course. The course covers recent research works in which topics include selected issues of modern biological studies interesting to members of discipline.

### **BS990 Graduate Student Seminar**

This course intends to enhance the skill of presentation and communication of the predoctoral students by providing them with an opportunity to present their own results obtained during their doctoral training. In this course, it is mandatory for students to present twice before they finish the Ph. D. program.